PREDICT®

Anticipate & Save®

CASIP ENGINEERING

KASEM

CASIP

Prognostics &
Health
Management
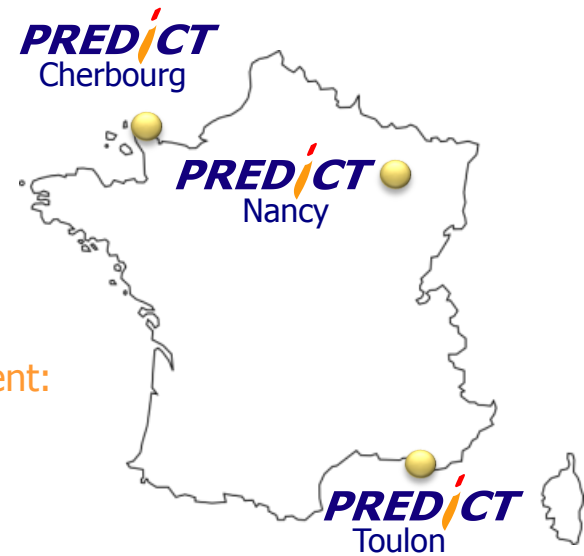
PREDICT

PREDICT

Management

- ✓ CEO: Dr. Jean-Baptiste LEGER
- ✓ CTO: David MOREL
- ✓ CSO: Pr. Benoit IUNG

Business

- ✓ Digital Technologies for Prognostic & Health Management:
  - ⇨ Realtime Monitoring
  - ⇨ Prognostic / Anticipation
  - ⇨ Health Management
  - ⇨ Investigation

PREDICT Cherbourg

PREDICT Nancy

PREDICT Toulon

Key Figures

- ✓ Investment in RTD: > 7 M€
- ✓ Equity: ~1 M€
- ✓ Treasury: ~400 k€
- ✓ Sales: 1,25 M€
- ✓ People: 15 Engineers

LORⓃTECH

PREDICT ፧ Key Facts

10 000+
Monitored equipment

Industrial

10+ years
Of operation

24h

Reliability

1 000+
Users

Efficiency

3-6
Months

Payback

15-25%
Increase of production

Performance

30-45%
Less downtime

Profitability

PREDICT Products & Services

- ✓ Assist Clients in Maintenance Engineering
    - ⇨ From user needs to implementation following

- ✓ Asset Health Management System Engineering
    - ⇨ From plant analysis to Health Assessment design

- ✓ Implementation of Solutions
    - ⇨ Proactive Real-time Monitoring **CASIP**®
    - ⇨ Health Management Platform **KASEM**®

- ✓ Services
    - ⇨ Failure anticipation, expertise and investigation
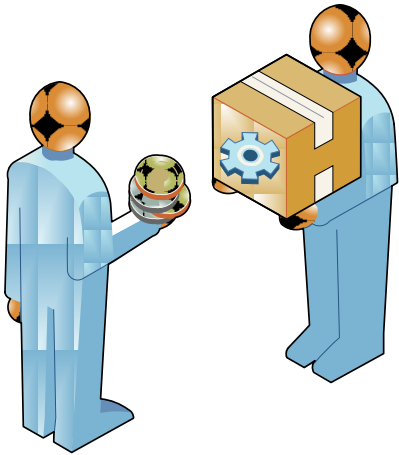
CASiP® & KASEM® Solutions

- ✓ **Realtime Monitoring**

- ✓ **Health Assessment and Diagnostic**

- ✓ **Failure Prognostic**

- ✓ **Proactive Therapy**

CASIP® & KASEM® Solutions

With more than 15 years of experience dedicated to Customers, PREDICT develops high technologies in :

Proactive Therapy : 2 complementary software platforms

CASIP Products Line	KASEM Products Line
Marketed since 2002	Marketed since 2006

• **Real time solution of Monitoring and Predictive Diagnostic** • Open, integrated and interoperable software • Real time monitoring of industrial installations • Dysfunction indicators elaboration • Users alert by proactive way to anticipate actions implementation	• **Collaborative platform of Prognostics, Health Management & Proactive Therapy** • Fleetwide Health Management • Predictive diagnostics & prognostics • Anticipation of therapeutic actions to implement • Continuous improvement of installations knowledge database

From few plant users (5 to 10) in 2004…	…to several hundreds by site in 2014.

ArcelorMittal	AREVA	AIRBUS GROUP	cea	DCNS	edf	ENGIE
Since 2002	Since 2003	Since 2010	Since 2011	Since 2004	Since 1999	Since 2001

Loyalty & recurrence

PREDICT - T-REX Workshop and Product Launch - ULMA Group - 2016-09-15

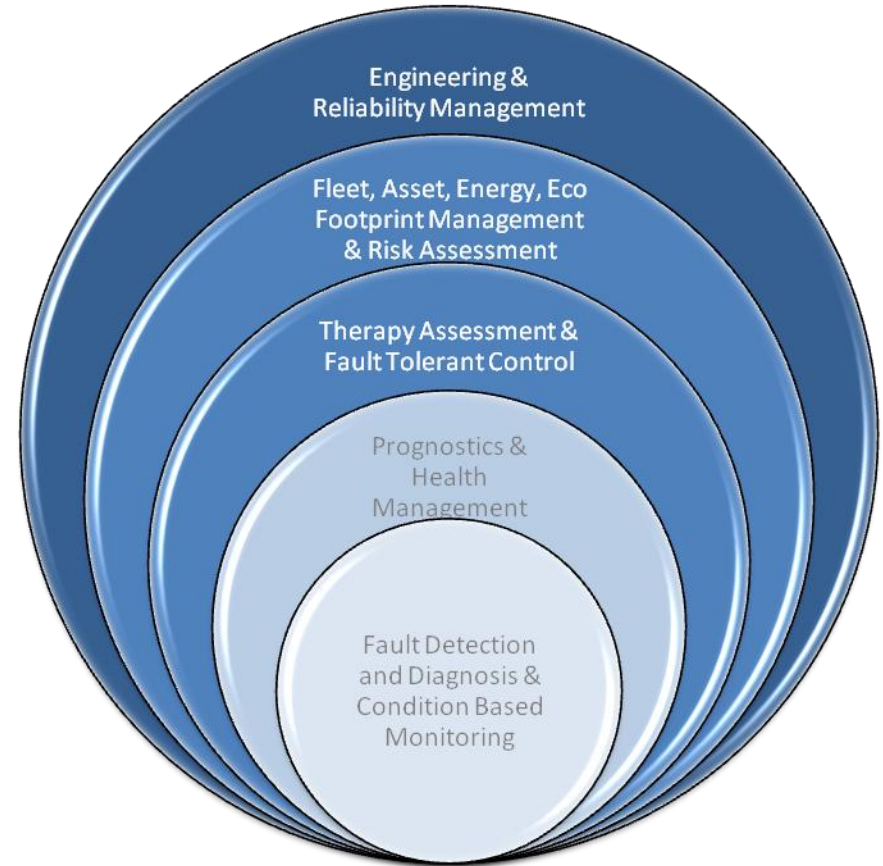# PREDICT "Vertical" Solutions

CASIP Engineering
- Function / Flow
- HAZOP / FMECA
- FTA / RCA
- Reliability Analysis

KASEM
- Therapy Assessment
- Fleet Wide Monitoring
- Health Management
- Diagnosis / Investigation / Prognosis

CASIP
- Fault Localisation
- Fault Isolation
- Fault Detection
- Condition Monitoring

Engineering & Reliability Management

Fleet, Asset, Energy, Eco Footprint Management & Risk Assessment

Therapy Assessment & Fault Tolerant Control

Prognostics & Health Management

Fault Detection and Diagnosis & Condition Based Monitoring

Common Repository

System and Flow Model
HAZard & Operability study
Failure Mode Effects Criticality Analysis
Fault Tree Analysis
Root Cause Analysis

RCM
Reliability Centred Maintenance

CBM
Condition Monitoring

Acquisition
Scaling
Filtering
Conditioning
Monitoring

CASiP
Engineering

CASiP
Knowledge Based System

CASiP

Prognostic & Health Management

Trend
Approximation
Extrapolation
Prediction
Remaining Useful Life

PHM

Fault Detection & Isolation

FDI

Characterisation
Detection
Recognition
Isolation
Identification

KASEM

PREDICT

KASEM®: PHM global process
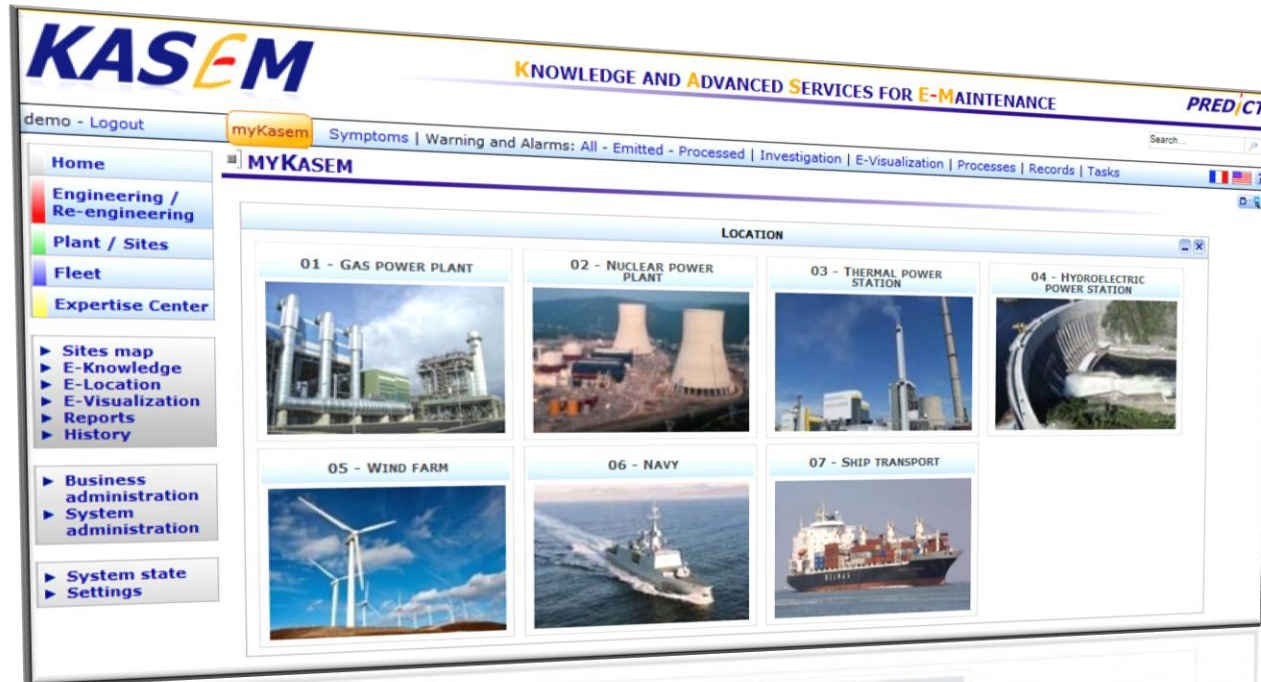
All along the life cycle
- ✓ Engineering – Operation – Feedback – Reverse Engineering

for a Plant
- ✓ Monitoring, Diagnostic, Prognostic, Investigation, Maintenance, Validation, Capitalisation, Optimisation

Visualisation, Situation, Event Log Book, Historian, Knowledge, Communication…

for a fleet
- ✓ Characterisation, Data Mining, case based research, best pratice…

for a support centre
- ✓ Expertise, feedback, optimisation, amelioration…

From Monitoring to Proactive Maintenance

Workflow

CMMS

ERP
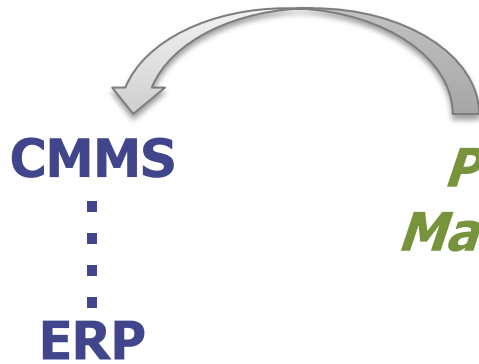
Sensors
Conditions - Usage

Proactive Maintenance

Monitoring

Predictive Diagnostic

Health Assessment

Prognostic

Knowledge base
KAS M®

Early Detection Warning

PRED CT
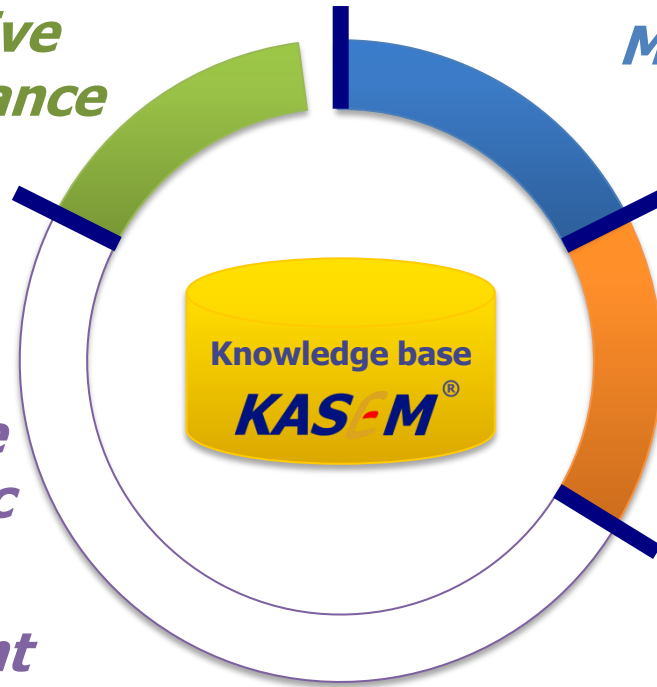
From Raw Data to Decision
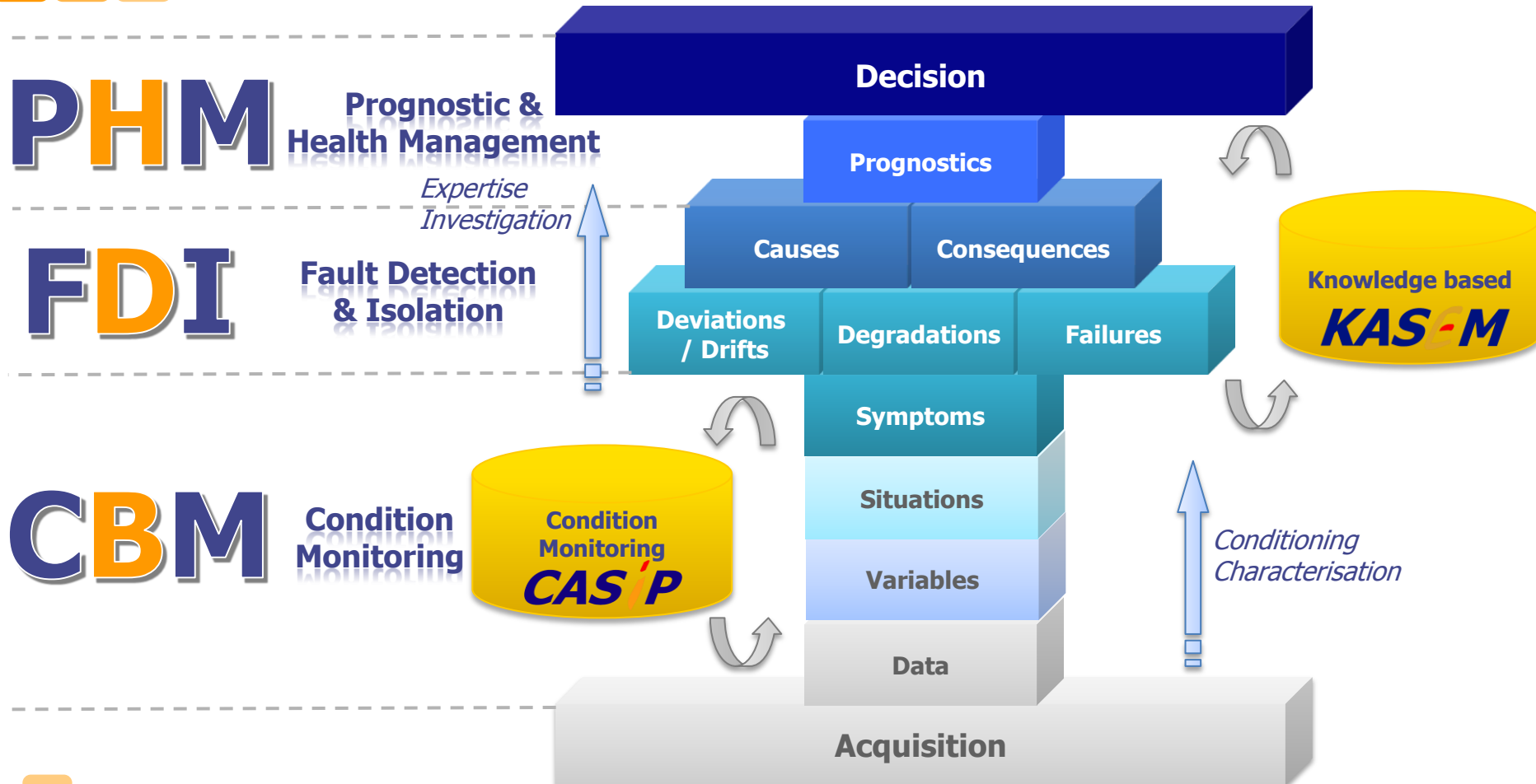
® This confidential document is PREDICT's property and must not be used or transmitted without its agreement

KASEM®: Health Management

Key Performance Indicators for efficient health state evaluation and decision-making

✓**KPI and health assessment**

✓**Data fusion and aggregation**

✓**Analytics**

✓**From an equipment to a fleet**

✓**Dashboard and automatic reporting**

Diesel Monitoring and Remote Diagnostic

Fleet: 12 warships / ~55 diesel engines
Objective: Fleet-wide monitoring, remote predictive diagnostic to optimise proactive maintenance and fleet-wide analytics to improve maintenance program and new build

- ✓ Embedded systems
- ✓ Interface with control system
- ✓ Sensors
- ✓ Wireless communication
- ✓ Remote Access
- ✓ Fleet-wide platform

Examples of architecture
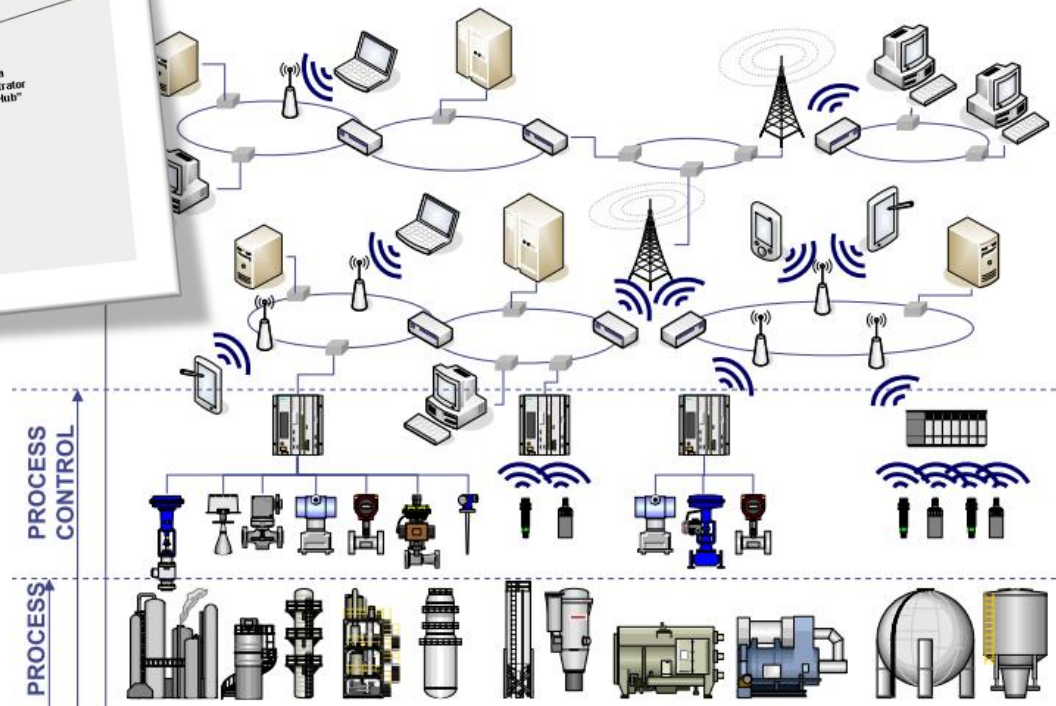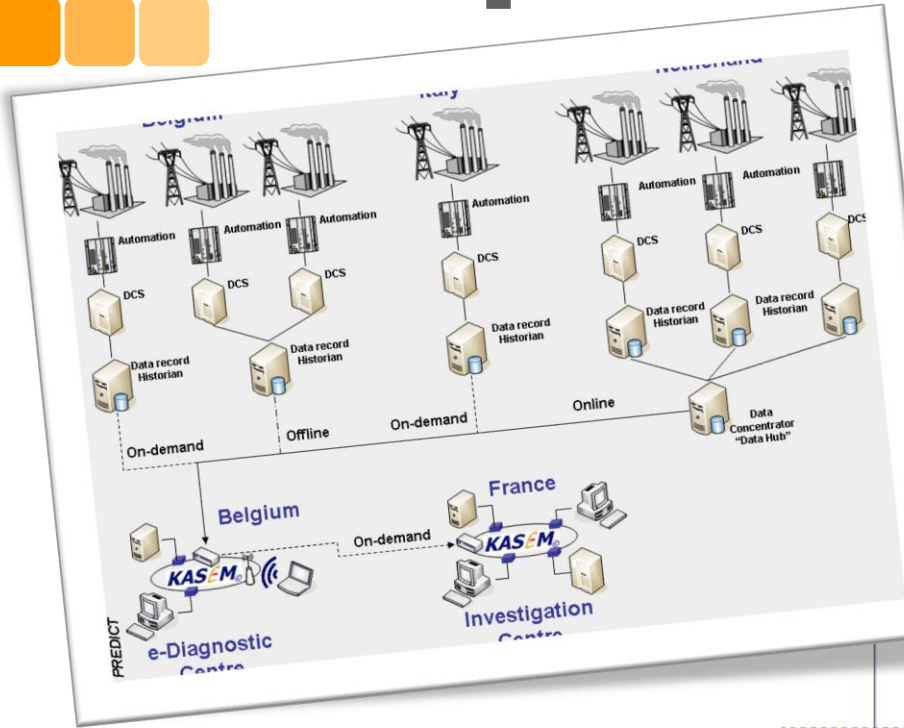
Fleet-wide Health Monitoring for Industry 4.0

Factories of the Future
Public Private Partnership

INNOVATIVE STRATEGIES FOR RENOVATION AND REPAIR IN MANUFACTURING SYSTEMS
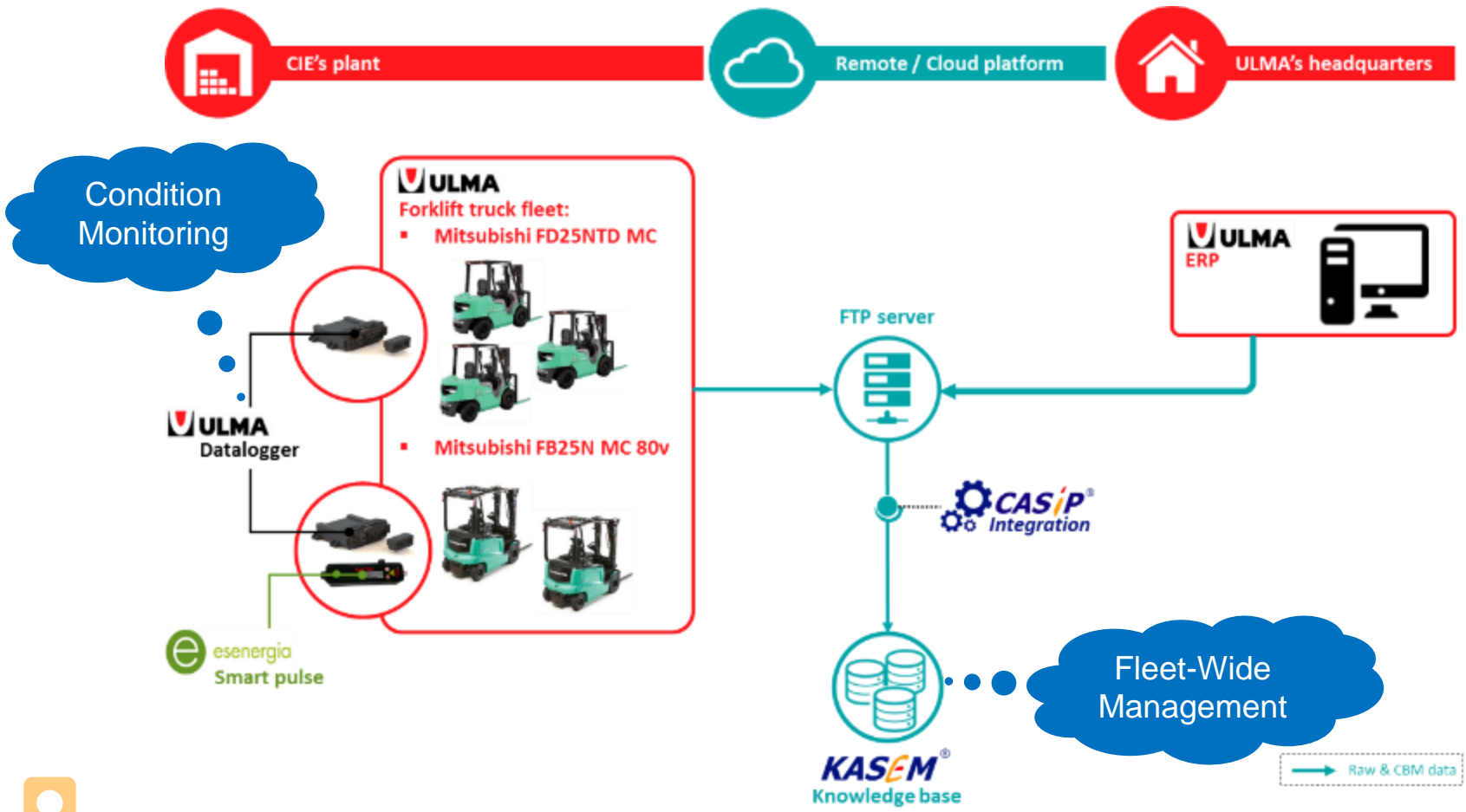
SEVENTH FRAMEWORK PROGRAMME

LIFECYCLE EXTENSION THROUGH PRODUCT REDESIGN AND REPAIR, RENOVATION, REUSE, RECYCLE STRATEGIES FOR USAGE&REUSAGE-ORIENTED BUSINESS MODELS

F. Peysson, D. Léon, C. Mozzati, R. Aras, JB. Léger

Industrial Vehicles Application

Data Flow & Platform

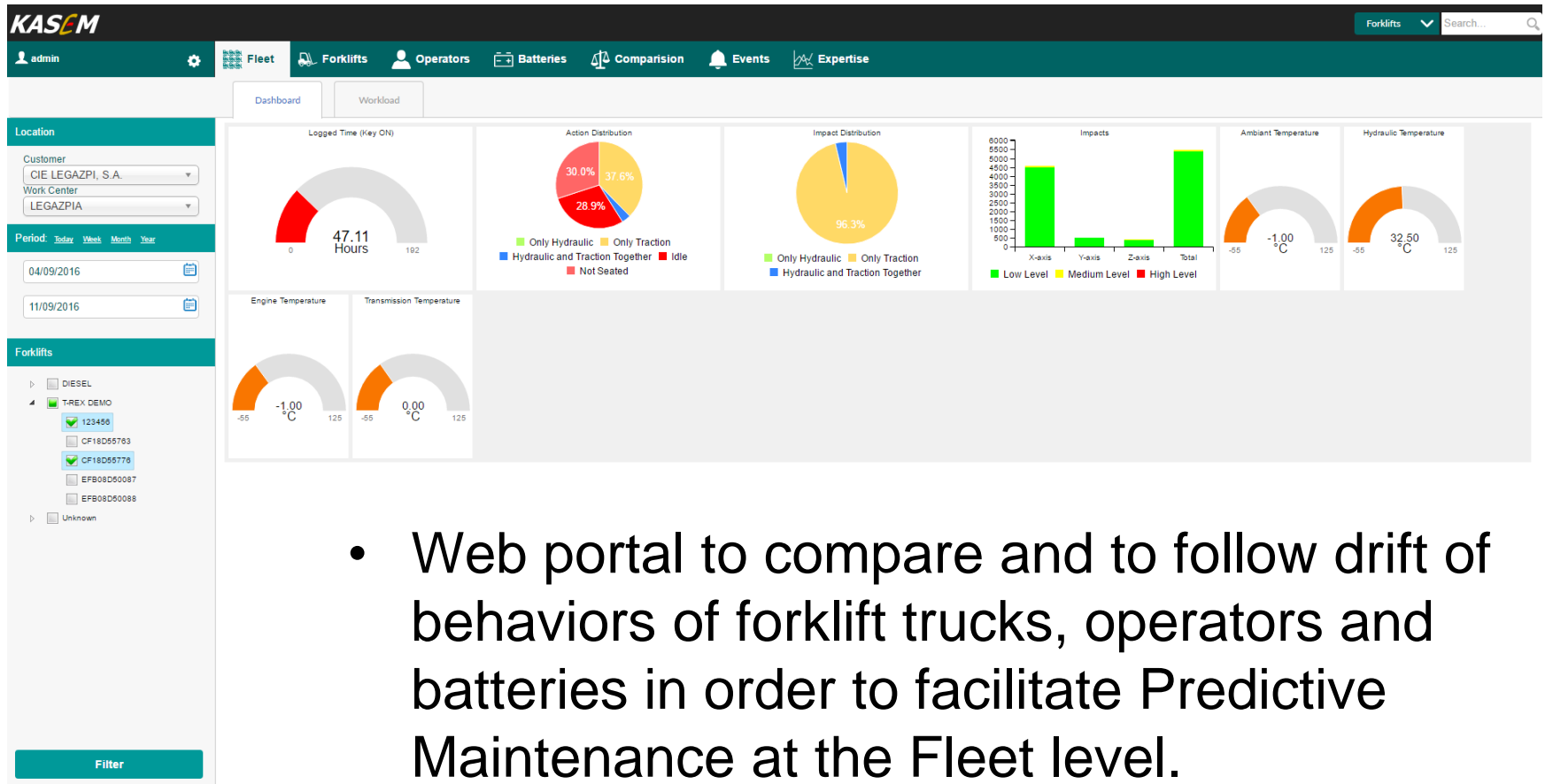Raw data and local alarms are transmitted to the cloud platform every 5 minutes.

Industrial Vehicles Application
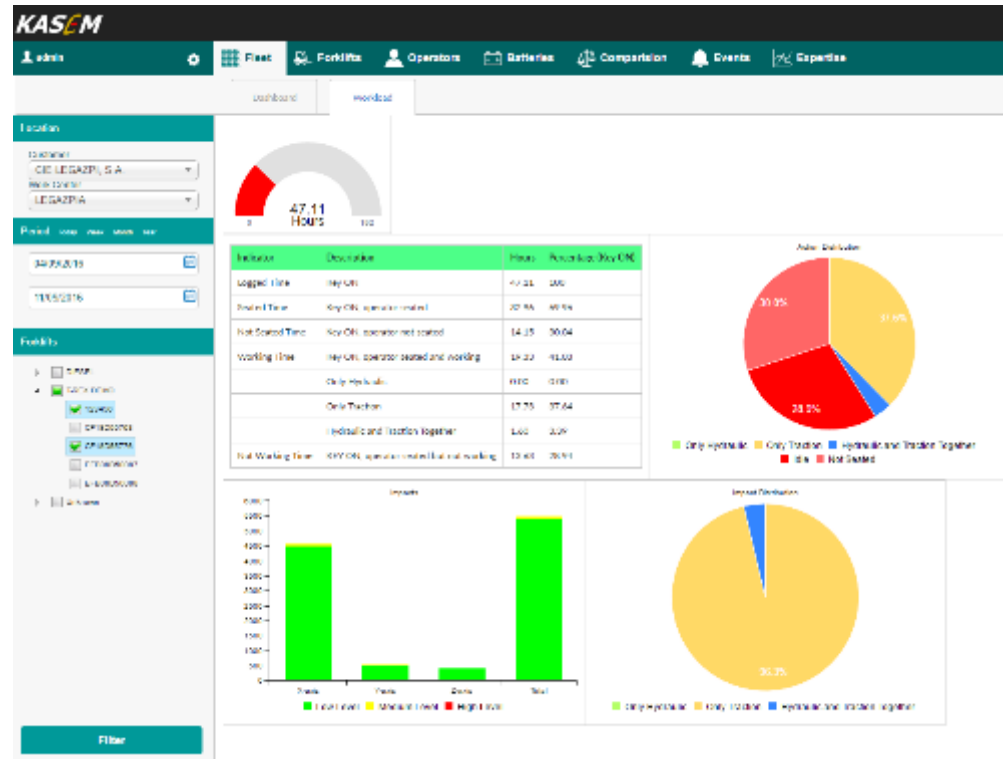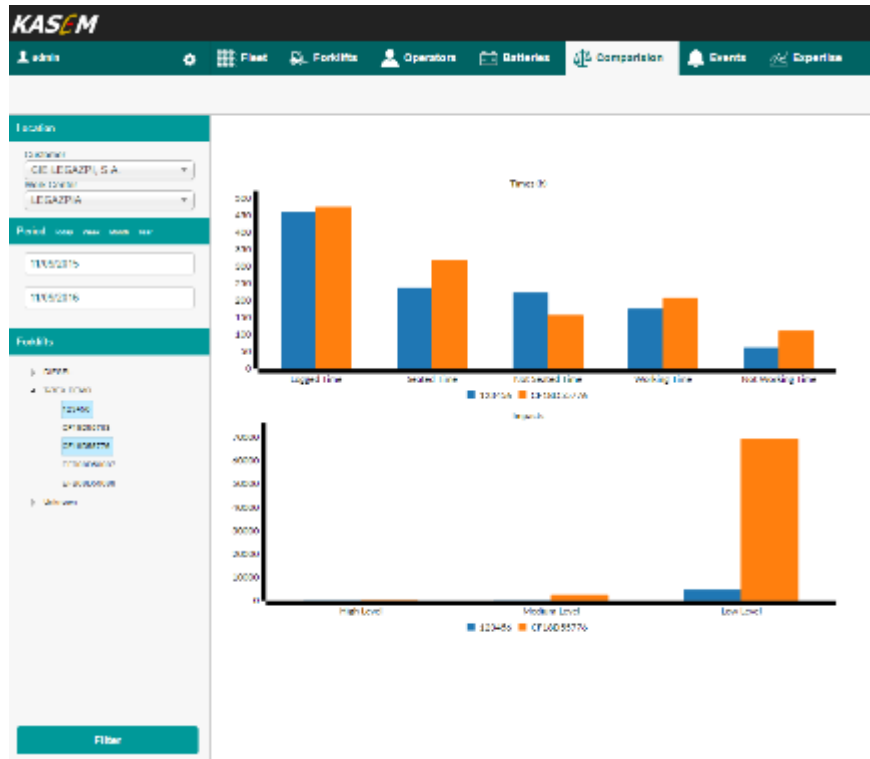## Fleet-Wide Manager

- Web portal to compare and to follow drift of behaviors of forklift trucks, operators and batteries in order to facilitate Predictive Maintenance at the Fleet level.

Industrial Vehicles Application
Performance

Usage and conditions comparison of forklift trucks

Industrial Vehicles Application
Performance

Behavior monitoring of electric forklift truck

Machine-Tools Application
Data Flow & Platform

Raw data are transmitted at end of a maintenance test session.

Machine-Tools Application
Fleet-wide tests follow-up

- # Mobile web application

  – Fleet Health of machines

  – Set of sessions of tests per machine, status and trends

  – Set of parameters per test session and status

Machine-Tools Application
Fleet-wide tests follow-up

- # Mobile web application

Fleet health status

Tests note historical

Visual state indicator

See details for specific machine
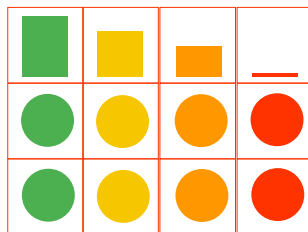
LIVE DEMO

Machine-Tools Application
Fleet-Wide tests session follow-up

Apps to facilitate Predictive Maintenance everywhere
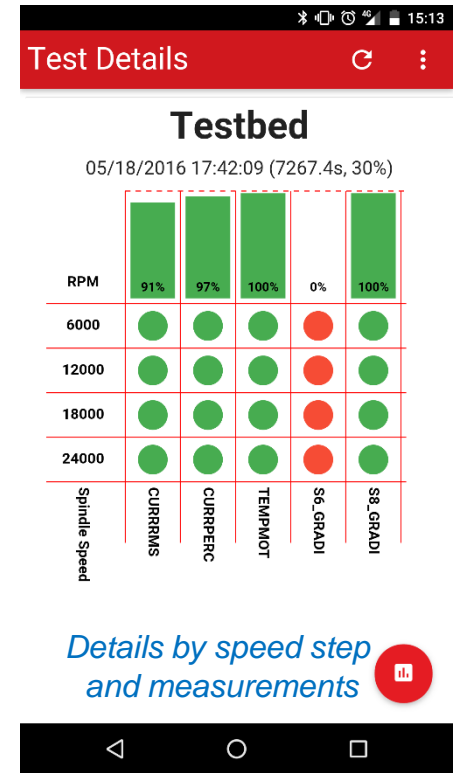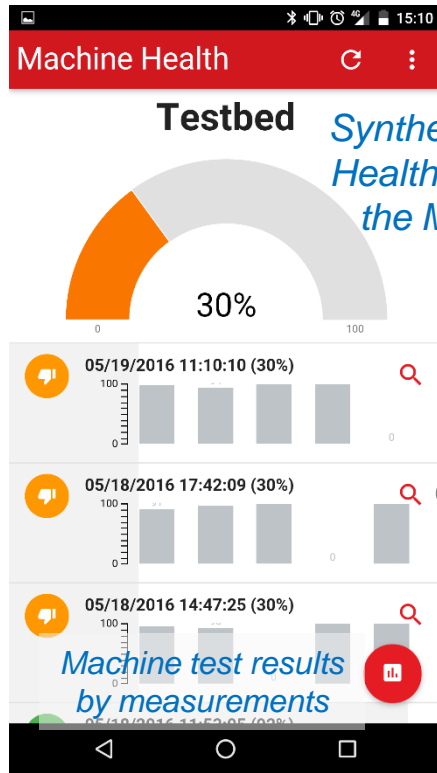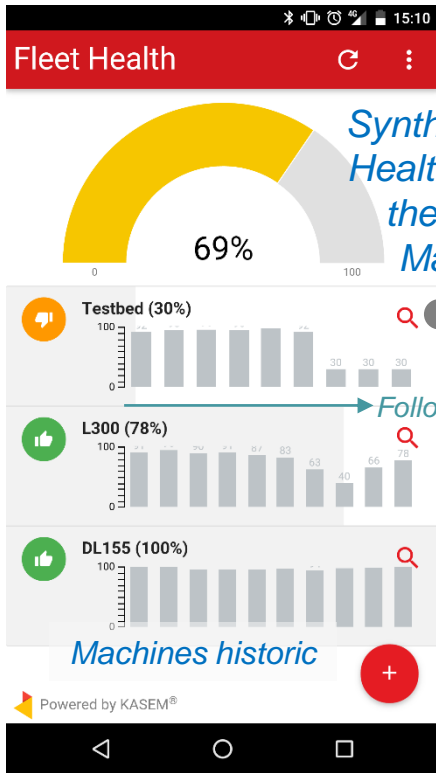
Synthetic Health Indexes Comparison

Fleet Health — 69%
- Testbed (30%)
- L300 (78%)
- DL155 (100%)

Machines historic

Powered by KASEM®

Synthesis of the Health Index for the Fleet of Machines

Follow-up and Trend

Machine Health — Testbed — 30%
- 05/19/2016 11:10:10 (30%)
- 05/18/2016 17:42:09 (30%)
- 05/18/2016 14:47:25 (30%)

Synthesis of the Health Index for the Machine

Machine test results by measurements

Test Details — Testbed
05/18/2016 17:42:09 (7267.4s, 30%)

RPM	CURRRMS	CURRPERC	TEMPMOT	S6_GRADI	S8_GRADI
	91%	97%	100%	0%	100%
6000	●	●	●	●	●
12000	●	●	●	●	●
18000	●	●	●	●	●
24000	●	●	●	●	●
Spindle Speed					

Details by speed step and measurements

Machine-Tools Application
Performance

Motor winding fault

Only motor temperature indicator is impacted.

Machine-Tools Application
Performance
Machine tools and fleet health

Test session level   **Machine level**   **Fleet level**

Robot System Application

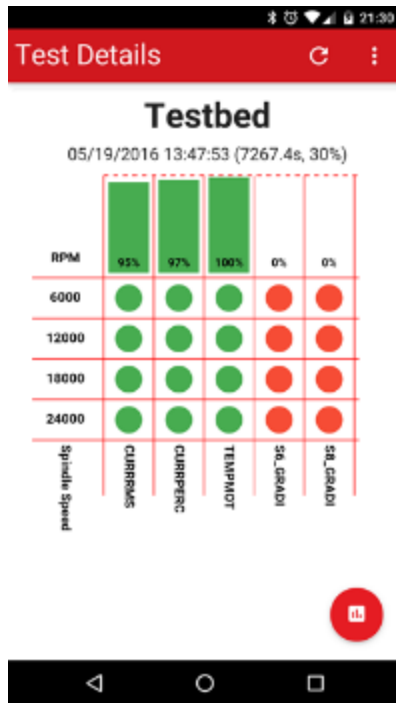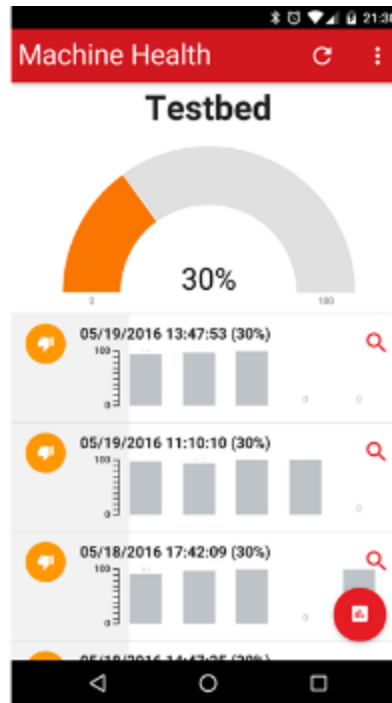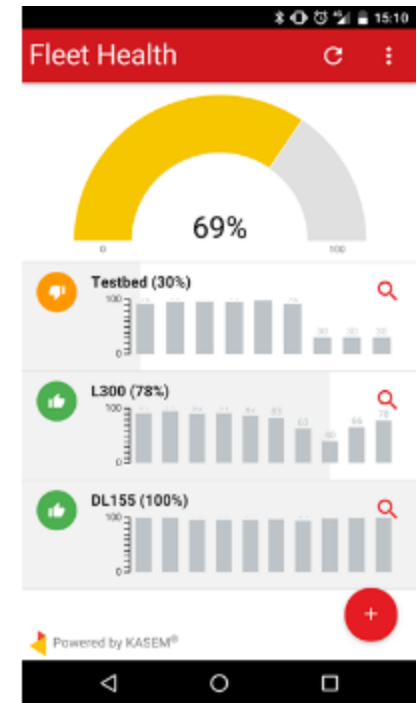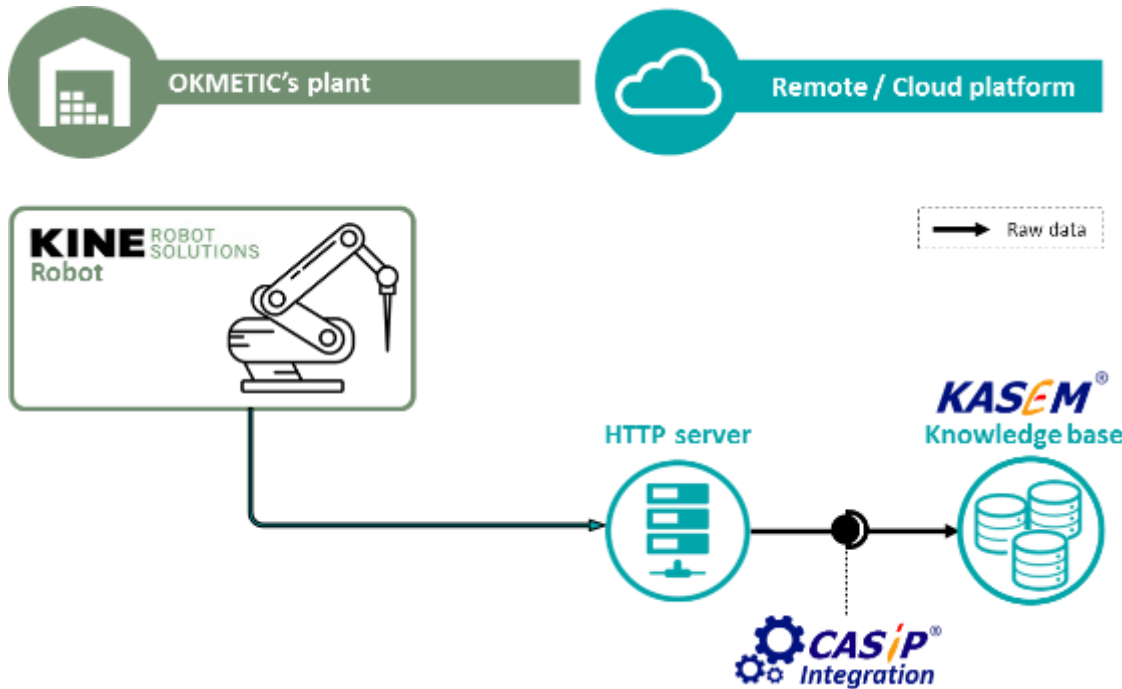| Information	Unit
Robot online	on/off (line)
Robot cycle time	s
# of processed products per hour	product/hour
# of processed products since last maintenance	product
Uptime since last maintenance	-
Robot temperature	°C
Robot power consumption	-
Pressure of air supply	-
Pressure of secondary gas supply	-
Level of vacuum	-
Flow of compressed air	-
Flow of secondary gas	-
Status of cart position	in/ not in (place)
Status of safety	-
# of cart locking cycles	-
Cart locking cylinder moving	-
Cart locking cylinder movement time	s
Product gripped	gripped/ not gripped

Raw data are transmitted each second to the cloud platform.

Robot System Application
Operation Reports
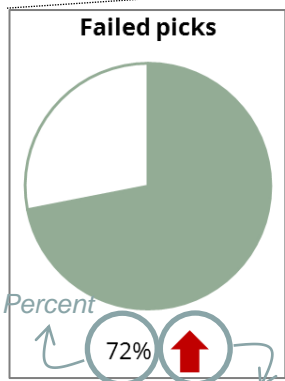

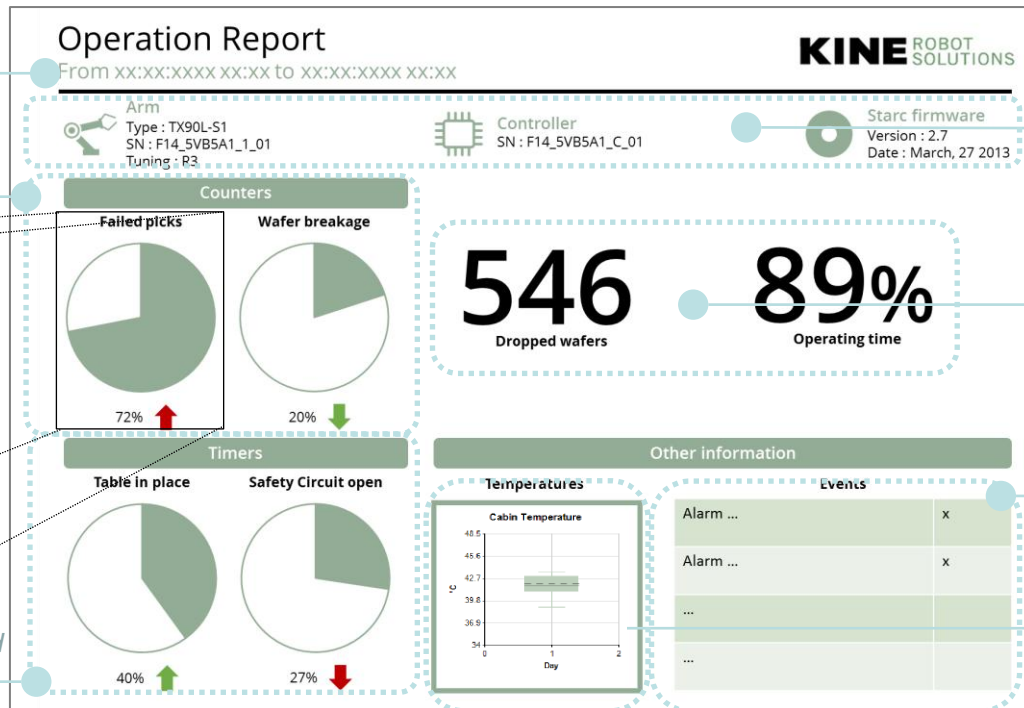User defined periodic report

Counter type KPI

Timer type KPI

Automatic system's configuration detection

Period's key facts

Main events' log

Temperatures' statistics

Robot System Application
Performance

Daily report of robot performances
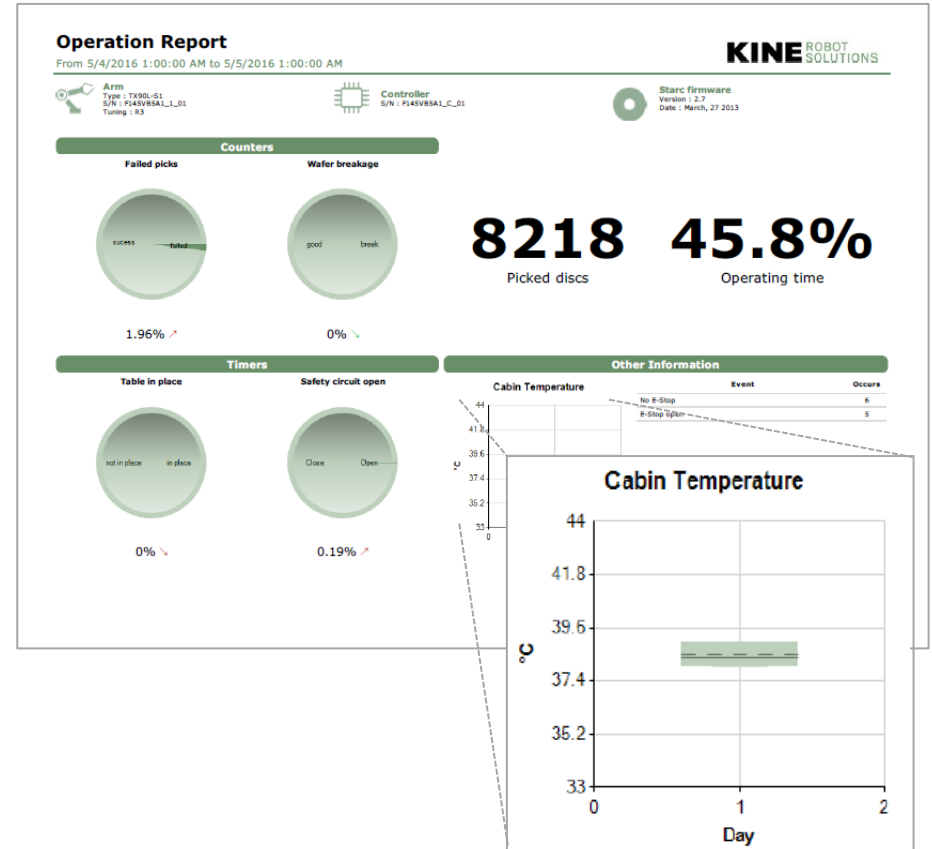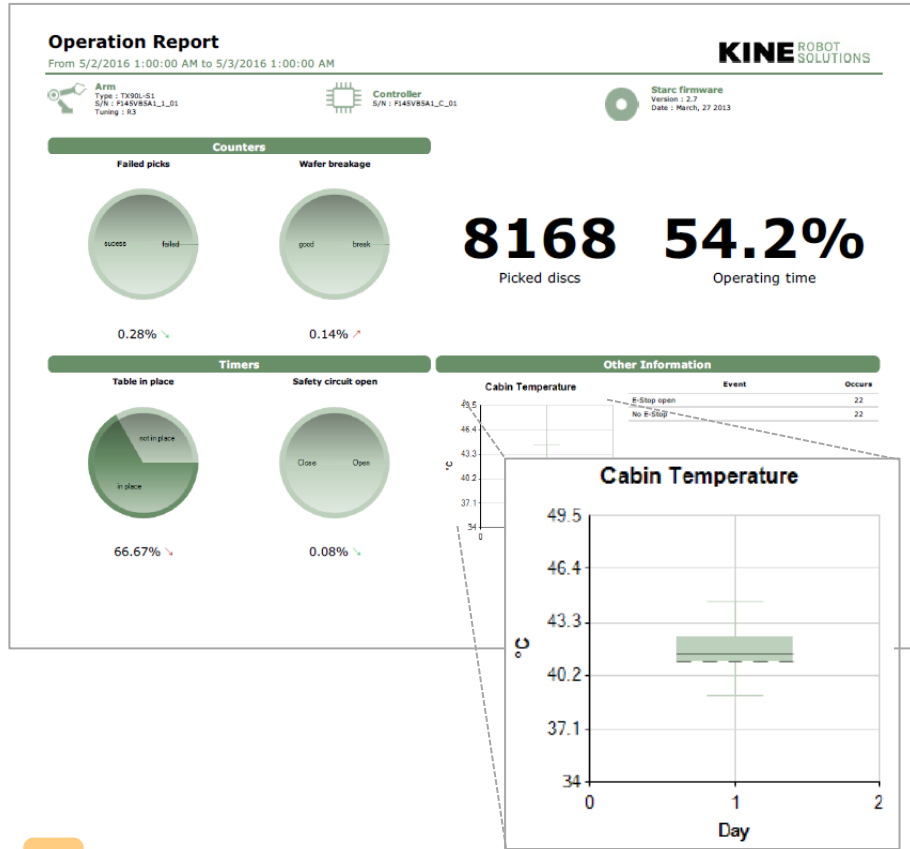
Return on Investment

- Return on investment: **10 times**
- Benefits starting between **3 to 6 months** after solutions commissioning
- Reduction in maintenance costs: **25% to 30%**
    - Proactive maintenance program can provide a cost saving of 8% to 12% over a program utilizing preventive maintenance strategies
    - Cost saving opportunities of 30% to 40% could easily be realized regarding a reactive maintenance approach and material condition.
- Elimination of breakdowns: **70% to 75%**
- Reduction in downtime: **35% to 45%**
- Increase in production: **20% to 25%**
- Maintenance planning postponed from 30% to 40% -> **only 3 maintenance cycles to save one**

Predictive
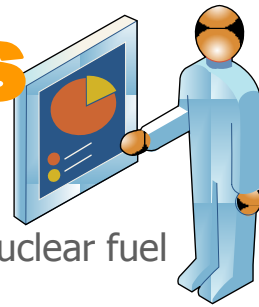- 67% OEE
- 74% plant throughput
- 34% Asset downtime

Reliability centred
- 86% OEE
- 91% plant throughput
- 13% Asset downtime

Proactive
- 93% OEE
- 97% plant throughput
- 3% Asset downtime

PREDICT

Some verified experiences

Prognostic range 6 months

Nuclear Fuel Recycling
- Design and development of prognostic system to anticipate the nuclear fuel recycling workshops breakdowns
- Implementation of service contract for breakdown anticipation

Prognostic range 3 months

Nuclear Fuel Manufacturing
- Design and development of prognostic system to anticipate nuclear fuel manufacturing lines breakdowns
- Service contract Implementation of breakdowns anticipation

Nuclear Energy
- Design and development of prognostic solution to anticipate nuclear auxiliary systems breakdowns

Prognostic range 2 months

Navy
- Design and development of prognostic solution to anticipate frigates propellant system breakdowns and power supply failures

Prognostic range 1 month

Power Plant
- Design and development of prognostic system to avoid power plant sea water cooling systems fouling

PREDICT

Some References

Aeronautics and Space
- ✓ AIRBUS D&S, Dassault Aviation, SNECMA, THALES…

Chemistry and Oil
- ✓ AREVA NC, NOVASEP , TOTAL, NESTE OIL (Fi)…

Defense
- ✓ AREVA TA, CEA, DCNS, DGA, SPHEREA…

Power Energy (included Renewable Energy)
- ✓ ALSTOM, AREVA SA, AREVA SE, DALKIA, DCNS, EDF, EDP (P), ENGIE (B & NL), HUST (China), IBERDROLA (E), PROET (P), SINTEF (N), STEG (Tn)…

Automotive, Manufacturing and Steel Industry
- ✓ ARC Internat., ARCELORMITTAL, GORATU (E), IMERYS (UK), INNOTHERA, KINE (Fi), LDC, SOLYSTIC, ST MicroElectronics, STORAENSO (FI), ULMA (E)…

Nuclear Industry
- ✓ AREVA NC, AREVA NP, CEA CESTA (LIL), CEA Marcoule, EDF, EURIWARE, INTERCONTROLE, JSPM, SGN…

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